



Intel[®] 925X and 925XE Express Chipset Memory Controller Hub (MCH)

White Paper

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†Look for systems with the Intel® Pentium® 4 Processor with HT Technology logo and also including an Intel® 925X, 925XE or 915 Express chipset (see the product spec sheet or ask your salesperson). Performance and functionality will vary depending on (i) the specific hardware and software you use and (ii) the feature enabling/system configuration by your system vendor. See <http://www.intel.com/info/hyperthreading> for information on HT Technology or consult your system vendor for more information.

Φ Intel® Extended Memory 64 Technology (Intel® EM64T) requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel EM64T. Processor will not operate (including 32-bit operation) without an Intel EM64T-enabled BIOS. Performance will vary depending on your hardware and software configurations. See www.intel.com/info/em64t for more information including details on which processors support EM64T or consult with your system vendor for more information.

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Revision History

Revision Number	Description	Revision Date
-001	Initial Release.	June 2004
-002	Added Intel® EM64T Support Information	August 2004
-003	Added Intel® 925XE Express chipset information	November 2004

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1 Introduction

This document details the Intel® 925X and 925XE Express chipset memory controller hub (MCH) key benefits and operation. It is intended for a technical audience interested in learning about the 925X and 925XE Express chipset architecture.

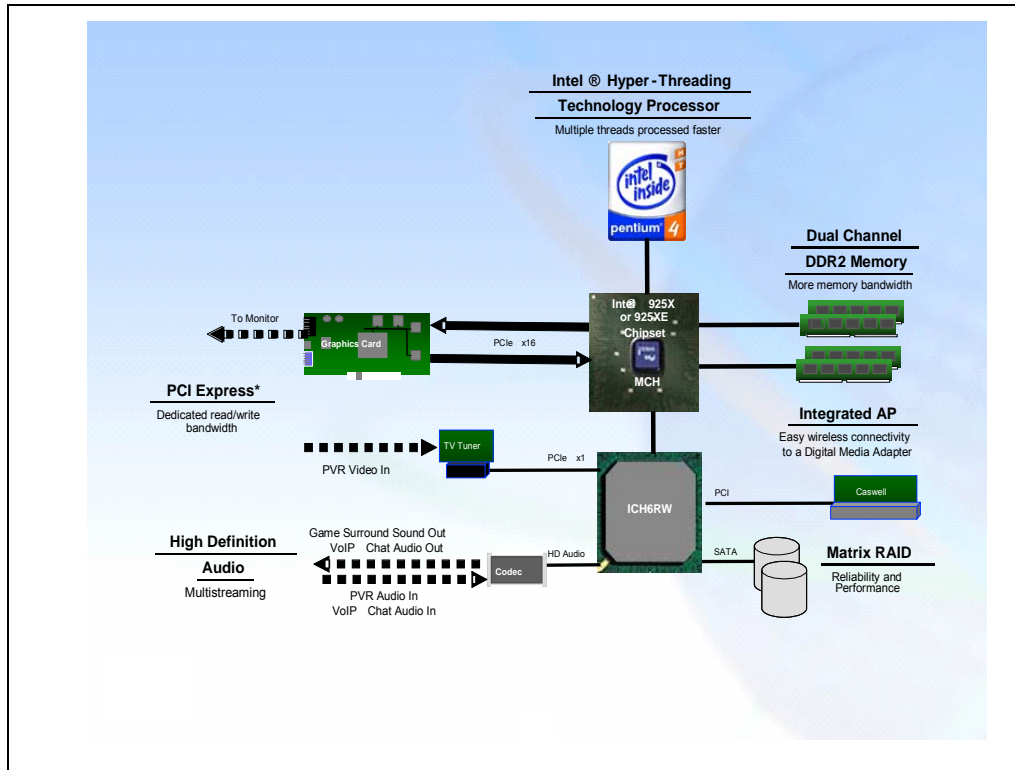
Note: *Information pertaining only to the Intel® 925XE Express Chipset memory controller hub (MCH) features will be italicized in this document.*

Please refer to the Intel® I/O Controller Hub 6 / 6R / 6W (ICH6) / (ICH6R) / (ICH6W) White Paper for complete details on the I/O hub controller.

The 925X and 925XE Express chipsets are Intel's first PCI Express* and DDR2 chipset for the Intel® Pentium® 4 processor in the LGA775 package. The 925X and 925XE Express chipset MCH, with its enhanced architecture, delivers an efficient high-bandwidth communication channel connecting the processor, system memory, I/O subsystem, and other components together to deliver a stable high performance desktop or workstation platform solution. The 925X and 925XE Express chipset MCH also provides a PCI Express Graphics Port interface for discrete adapters.

For great workstation application flexibility, the 925X and 925XE Express chipset is specifically designed to support Intel® Extended Memory 64 Technology Φ (Intel® EM64T) enabling 64-bit memory addressability. Select versions of the Pentium 4 processor support Intel EM64T as an enhancement to Intel's IA-32 architecture on workstation platforms. This enhancement enables the processor to execute operating systems and applications written to take advantage of Intel EM64T. Further details on the 64-bit extension architecture and programming model can be found in Figure 1 illustrates how the 925X and 925XE Express chipset MCH connects the processor and various components to make up a complete desktop platform.

Figure 1. Intel® 925X and 925XE Express Chipset Block Diagram



The introduction of the 925X and 925XE Express chipset MCH brings high performance, flexibility and stability to Pentium 4 processor-based systems. With the support of 533 MT/s and 800 MT/s processor system bus *the* Intel(R) Extended Memory 64 Technology Software Developer Guide at <http://developer.intel.com/technology/64bitextensions/>.

Φ Intel® Extended Memory 64 Technology (Intel® EM64T) requires a computer system with a processor, chipset, BIOS, operating system, device drivers and applications enabled for Intel EM64T. Processor will not operate (including 32-bit operation) without an Intel EM64T-enabled BIOS. Performance will vary depending on your hardware and software configurations. See www.intel.com/info/em64t for more information including details on which processors support EM64T or consult with your system vendor for more information.

The introduction of the 925X Express chipset MCH brings high performance, flexibility and stability to Pentium 4 processor-based systems. With the support of 533 MT/s and 800 MT/s processor system bus (925XE also supports 1066 MT/s), single- or dual-channel DDR2 400/533 system memory, discrete cards, the 925X and 925XE Express chipset MCH provides high system flexibility and scalability. In addition, the 925X and 925XE Express Chipset-based platforms use a single, innovative Intel® software stack, adding stability to the whole platform.

1.1 Processor Interface

The 925X and 925XE Express chipset MCH supports the host bus frequencies of 533 MT/s and 800 MT/s. By providing a bandwidth of up to 6.4 GB/s with 800 MT/s-enabled processors, the 925X and 925XE Express chipset MCH delivers higher throughput when accessing memory and I/O devices, to improve system performance. The 32-bit host addressing is supported, and up to 4 GB of the processor's memory address space is decoded. The 925X and 925XE Express chipset MCH implements its own cache line size of 64 bytes to match the cache line size of the processor. This allows an entire 64-byte cache line to be transferred in two bus clocks, enabling faster data transfers for today's demanding applications. It also supports Dynamic Bus Inversion (DBI), which limits the number of data signals that are driven low on the bus on each data phase. This performance significantly decreases the power consumption of the 925X and 925XE Express chipset MCH. In addition, the 925X and 925XE Express chipset MCH host bus implements GTL+ on die termination to help reduce the system BOM cost.

The 925XE Express chipset MCH supports the host bus frequencies of 533 MT/s, 800 MT/s, and 1066 MT/s.

1.2 System Memory Interface

The 925X and 925XE Express chipset MCH memory interface is designed to be flexible and can be configured through a set of registers to support either single- or dual-channels of DDR2 memory (400 MHz or 533 MHz DDR2) SDRAM memory. This allows up to 8.5 MB/s of memory bandwidth available, providing a balanced platform. DDR2 memory capability supports two data operations being completed within one clock cycle, resulting in faster data transfer and higher memory bandwidth. This translates into twice the throughput of regular SDRAM. The 925X and 925XE Express chipset MCH memory interface can support up to four double-sided DIMMs for a maximum of 4 GB of system memory. The memory technologies supported are 256-Mb, 512-Mb, and 1-Gb SDRAM technologies.

The 925XE Express Chipset supports DDR2 memory (533 MHz) with 3-3-3 timings.

The 925X and 925XE Express chipset MCH is equipped with many advanced system memory interface features to create a balanced performance environment for the platform. Twelve pairs of DDR2 system memory clocks are integrated into the MCH. This eliminates the need for external memory clocks to the DIMMs, and allows better control of system timings for higher system robustness. The memory controller supports the memory thermal management capability that increases the system reliability by decreasing thermal stress on the system memory and the 925X and 925XE Express chipset MCH. Suspend-to-RAM support allows for environmentally friendly and energy efficient systems by enabling lower power states when the system is idle.



With two 64-bit wide data channels, the memory controller supports up to 64 simultaneously open pages (four ranks of eight bank devices * 2 channels) in dual-channel mode and up to 32 open pages in single-channel mode, reducing the access time to system memory. The MCH also supports Data Masking by providing eight additional data masking signals from the MCH to memory. Byte writes of less than a Qword are allowed to increase memory bandwidth.

New to the 925X and 925XE Express chipset MCH is support of interleaved mode. This mode provides maximum performance on real applications. Addresses are ping-ponged between the channels, and the switch happens after each cache line (64-byte boundary). If two consecutive cache lines are requested, both may be retrieved simultaneously, since they are guaranteed to be on opposite channels. To achieve interleaved mode, both channels of memory must be populated with equal memory capacity, but the technology and device width may vary from one channel to the other.

1.3 Direct Media Interface

The 925X and 925XE Express chipset MCH utilizes the Direct Media Interface (DMI) as the chip-to-chip connection between the MCH and the I/O controller hub 6 (Intel® ICH6). This high-speed interface integrates advanced priority-based servicing allowing for concurrent traffic and true isochronous transfer capabilities. Base functionality is completely software transparent permitting current and legacy software to operate normally.

1.4 PCI Express* x16 Graphics Interface

The 925X and 925XE Express chipset MCH PCI Express x16 Graphics interface is designed to provide flexibility as well as performance. For users that demand the latest graphics cards, upgrade through the PCI Express interface is simple. The MCH contains one 16-lane (x16) port intended for an external card. The port is fully compliant to the *PCI Express Base Specification* revision 1.0a, operates at a frequency of 2.5 Gb/s on each lane while employing 8b/10b encoding, and supports a maximum theoretical bandwidth of 40 Gb/s each direction. This allows the 925X and 925XE Express chipset MCH to be paired with today's highest performance standalone graphics solutions.

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2 Summary

The 925X and 925XE Express chipset enables ultimate flexibility with different system bus speeds, memory configurations, and graphics solutions. The 925X and 925XE Express chipset supports 800 MT/s and 533 MT/s system bus for LGA775 processors, 400 MHz/533 MHz DDR2 memory in single- or dual-channel mode, and discrete PCI Express x16 Graphics cards.

The 925XE Express chipset MCH supports 533 MT/s, 800 MT/s, and 1066 MT/s system bus for the LGA775 processors, 400 MHz/533 MHz DDR2 memory in single- or dual-channel mode, and DDR2 memory (533 MHz) with 3-3-3 timings.

Intel 925X and 925XE Express chipset-based platforms also offer integrated Hi-Speed USB 2.0, High Definition Audio for improved sound quality and new audio usage models and enhanced RAID support. The 925X and 925XE Express chipset ensures that tomorrow's applications will run best on Pentium 4 processor platforms.

The 925X and 925XE Express chipset enables lower system price points with graphics and hi-speed USB 2.0 integration. The 925X and 925XE Express chipset delivers a complete range of support for the Pentium 4 processor. This chipset is a great choice for users who want superb graphics quality for the latest digital entertainment. It is also an ideal solution for business users who demand highly stable drivers and value the Intel® Stable Image Technology quality.

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